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## **Waterbird and Wetland Monitoring at The Emiquon Preserve**

### **Preliminary Annual Report 2010**

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Prepared for: The Nature Conservancy

Project Name: Monitoring of Key Attributes and Indicators of Waterfowl at The Nature  
Conservancy's Emiquon Preserve  
Contract Number: C07-032



ILLINOIS  
NATURAL  
HISTORY  
SURVEY

INHS Technical Report 2011 (07)

Date of Issue: 14 January 2011

## **ACKNOWLEDGEMENTS**

Funding for this project was provided by The Nature Conservancy's Illinois River Project Office, contract number C07-032. We would like to thank D. Blodgett, J. Beverlin, T. Hobson, M. Lemke and S. McClure of the Illinois River Project Office and J. Walk of the Peoria Office for their input and guidance in our monitoring activities. We also appreciate our colleagues at the Illinois Natural History Survey's (INHS) Illinois River Biological Station for allowing use of field and laboratory equipment. Finally, we thank D. Holm (Illinois Department of Natural Resources) and B. Bushman (INHS) for their assistance in conducting brood surveys and M. Cruce for providing flight services during waterfowl inventories.

Historically, the wetlands of the Illinois River valley (IRV) provided extensive and valuable habitat to migrating waterbirds and other wetland-dependent wildlife in the Upper Midwest. Despite dramatic anthropogenic alterations, the IRV remains a critical ecoregion for migratory birds. Restoration and reclamation efforts are ongoing in attempts to return structure and function to backwater wetlands in the region. For example, The Nature Conservancy's (TNC) Emiquon Preserve (hereafter, Emiquon) is the most substantial effort to date, directly restoring, enhancing, or protecting >2,700 ha of former wetlands and associated uplands in the central IRV. To guide the restoration process at Emiquon, TNC identified key ecological attributes (KEAs) of specific biological characteristics or ecological processes that would indicate restoration success (The Nature Conservancy 2006), and several KEAs were related to waterbird communities and their habitats. Thus, we monitored the response of wetland habitats and waterbirds to restoration efforts at Emiquon relative to desired KEAs during 2010. Specifically, we evaluated: 1) abundance, diversity, and behavior of waterfowl and other waterbirds through counts and observations; 2) productivity by waterfowl and other waterbirds through brood counts; 3) plant seed and invertebrate biomass for waterfowl during migration and breeding, and; 4) composition and arrangement of the vegetation community through geospatial wetland covermapping. Herein, we report preliminary results of our monitoring efforts during 2010. A final report is forthcoming upon completion of sample and data processing.

## **METHODS**

### **Avian Abundance**

We estimated abundance of avifauna by species (Table 1) at Emiquon during spring migration with a spotting scope and binoculars from fixed vantage points. Additionally, we counted birds while traveling between vantage points. We initiated bi-weekly inventories when

ice receded (early March) and concluded around mid-April, when most migrants had departed.

Although our ground inventories were designed to monitor waterfowl, we recorded abundance of raptors and other waterbirds encountered incidentally.

We also estimated waterbird abundance aerially at Emiquon as part of the Illinois Natural History Survey's (INHS) waterfowl inventories (Havera 1999). Aerial inventories were conducted approximately weekly (weather permitting) during spring and fall from a fixed-wing, single-engine aircraft at altitudes of 60–140 m and speeds of 160–240 km/hr (Havera 1999:186, Stafford et al. 2008). A single observer estimated abundances of American coots, American white pelicans, double-crested cormorants, bald eagles and waterfowl by species (except wood ducks).

We converted abundance estimates to use-days to evaluate overall waterbird use of Emiquon (UDs; Stafford et al. 2008). Use-days are estimates of bird abundance extrapolated over a period of interest (i.e., fall or spring). For example, 100 birds using a wetland for 10 days equals 1,000 UD. This method is useful for comparing waterbird use among sites, years, and seasons.

Due to redundancy with our aerial waterfowl inventories, fall ground counts at Emiquon were discontinued in 2010. Thus, our 2010 fall abundance, UD estimates, and yearly comparisons were based upon aerial inventory data.

### **Waterfowl Behavior**

We conducted behavioral observations using scan sampling to evaluate the functional response of ducks to wetland restoration and habitat change at Emiquon (Altmann 1974). This method allowed for a rapid assessment of waterfowl behavior that could be conducted simultaneously with ground counts (Paulus 1988). One scan sample consisted of recording the

behavior (e.g., feeding, resting) and sex of 50 individuals of the same species, in the same flock. We attempted to conduct 10 scan samples during each ground count for species that were present throughout the migration period to maximize sample sizes and inference. However, dense vegetation, long distances between observation points and duck concentrations, and difficulty in approaching flocks undetected prevented us from making some observations.

### **Brood Observations**

We monitored waterbird production at Emiquon in 2010 through passive brood observations (Rumble and Flake 1982). We conducted bi-weekly brood surveys between early June and mid-August using 4 observers at fixed points along the east and west shores of Thompson Lake and on the north levee. This approach intended to maximize coverage and minimize double counting and disturbance associated with a single observer moving between points. Surveys began at sunrise and lasted for one hour to coincide with the period when broods are most active (Ringelman and Flake 1980, Rumble and Flake 1982). During each survey, we continually scanned the wetland using spotting scopes and binoculars and documented species, number of young and adults, and brood age class of all waterbirds (Gollop and Marshall 1954).

### **Aquatic Invertebrates**

We collected 20 sweep-net samples bi-monthly during waterbird breeding and brood-rearing periods (i.e., April–August) in 2010 ( $n = 60$  total samples) to estimate abundance of nektonic invertebrates. We collected samples from random locations in shallow water ( $\leq 46$  cm) along the margins of Thompson Lake using a  $454 \text{ cm}^2$  ( $\sim 0.05 \text{ m}^2$ ) D-frame sweep-net with a  $500 \text{ }\mu\text{m}$  mesh (Voigts 1976, Kaminski and Murkin 1981). We preserved samples in 10% buffered formalin solution containing Rose Bengal until processing. In the laboratory, we will rinse samples through a  $500 \text{ }\mu\text{m}$  sieve to remove substrate and vegetation. Invertebrates will be

removed from samples by hand and identified according to the lowest practical taxonomic level (e.g., Family; Pennak 1978, Merritt and Cummins 1996). Invertebrate samples will be dried at 70° C to constant mass and weighed to the nearest 0.1 mg using a Mettler electronic balance. Samples containing >200 individuals of a single invertebrate taxa will be sub-sampled (up to ¼) using a Folsom plankton splitter. We will convert invertebrate biomass estimates to per-unit-volume (mg/m<sup>3</sup>) to account for different volumes of water sampled with each net sweep. Processing of invertebrate samples is ongoing, and results will be included in the final version of the annual report.

### **Moist-soil Plant Seeds**

During 2010, we estimated above- and below-ground biomass of moist-soil plant seeds by extracting a 10-cm diameter x 5-cm depth soil core in standing vegetation at 20 random points along the west shore of Thompson Lake (Stafford et al. 2006, 2008, Kross et al. 2008). We collected soil cores during fall following seed maturation and froze samples in individually labeled bags until processing. Prior to sorting, we thawed core samples at room temperature and soaked them in a 3% solution of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) to dissolve clays (Bohm 1979:117, Kross et al. 2008). We washed samples with water through a #60 (250 µm) sieve and dried for 24 hours at 87°C (Greer et al. 2007, Stafford et al. 2008). We then threshed dried materials over a series of 4–5 sieves (mesh sizes 14 [1.40 mm], 18 [1.00 mm], 35 [500 µm], 45 [355 µm], and 60 [250 µm]) to further separate seeds from debris (Greer et al. 2007). We classified seeds as large if they were retained by the 14, 18 or 35 sieve (e.g., *Echinochloa spp.*, *Polygonum spp.*) and small if they remained in the 45 or 60 sieves (e.g., *Cyperus spp.*, *Amaranthus spp.*). We separated all large seeds from debris by hand and weighed to the nearest 0.1 mg using an electronic balance. Due to the extensive processing time, we sub-sampled a portion (≥2.5% by

mass) of some small seed samples to estimate biomass. The percent composition of seeds and debris in the subsample was multiplied by the small seed sample mass to extrapolate total small seed abundance in the core. We combined small and large seed masses to estimate total seed biomass per core (Stafford et al. 2008). We used biomass data from core samples to estimate overall moist-soil plant seed abundance (kg/ha; dry mass) at Thompson Lake using PROC MEANS in SAS v9.2 (SAS Institute, Inc., 2004).

We used our overall estimates of forage abundance to calculate estimates of energetic carrying capacity for waterfowl, expressed as energetic use-days (EUD). A EUD is defined as the number of days an area of land could support a mallard-sized duck (Reinecke et al. 1989). Our EUD calculations assumed an average true metabolizable energy of 2.5 kcal/g for moist-soil plant seeds (Kaminski et al. 2003) and an average daily energy expenditure of a mallard of 292 kcal/day (Prince 1979, Reinecke et al. 1989).

### **Wetland Covermapping**

We mapped all wetted areas of Thompson and Flag lakes during fall 2010 to document changes in wetland area, plant species composition, and vegetation assemblages. We traversed east-west transects spaced at 500 m intervals on foot, all-terrain vehicle, or by airboat and delineated changes in vegetation composition (e.g., moist-soil, hemi-marsh) using a handheld global positioning system (GPS; Bowyer et al. 2005, Stafford et al. 2010). We recorded plant species encountered along transect lines and delineated habitat assemblages or other physical features (e.g., vegetation islands, ditches) outside transects using a GPS and hand-drawn maps. We will digitize wetland vegetation in ArcGIS 10 using field notes and the GPS waypoints overlaid on 2010 high-resolution aerial photographs from Sanborn Map Company, Chesterfield, MO (Bowyer et al. 2005, Stafford et al. 2010).

Our classifications of wetland habitats at Emiquon generally followed those defined by Cowardin et al. (1979) and Suloway and Hubbell (1994). Woody vegetation was classified as bottomland forest if trees were >6 m in height or scrub-shrub if trees were ≤6 m tall (Cowardin et al. 1979). Other wetland classifications included non-persistent emergent vegetation (e.g., moist-soil plants; Fredrickson and Taylor 1982), persistent emergent vegetation (e.g., Cattails [*Typha spp*] and Bulrushes [*Scirpus spp*]), mud flats, floating-leaved aquatic vegetation (e.g., American Lotus [*Nelumbo lutea*]), aquatic bed (e.g., Coontail [*Ceratophyllum demersum*]), hemi-marsh (open water interspersed with persistent emergent; Weller and Spatcher 1965), and open water (water devoid of vegetation; Cowardin et al. 1979, Suloway and Hubbell 1994, Stafford et al. 2010). We also included a category to account for areas of upland vegetation (e.g., Goldenrod [*Solidago spp.*] and Foxtail [*Setaria spp.*]) growing within the wetland basin that were flooded or insular.

We attempted to be as descriptive as possible when categorizing wetland vegetation, and as such, some vegetation assemblages occurred in multiple categories. For instance, cattail was present in 3 habitat categories: hemi-marsh, persistent emergent, and cattail. We categorized cattail as hemi-marsh if there was a more-or-less even interspersed of cattail and open water or aquatic bed. We classified cattails as persistent emergent when they were accompanied by at least one other persistent emergent species (e.g., Bulrush, Bur Reed [*Sparganium spp.*], Prairie Cordgrass [*Spartina pectinata*]). Finally, our cattail category included only those areas that were dominated by dense, monotypic stands. We will create the 2010 wetland covermap this winter and include it in the final version of the annual report.

## **RESULTS**

### **Waterfowl Abundance**



### *Spring*

We conducted 5 ground inventories from 3 March to 20 April 2010 (Table 2) and 4 aerial inventories from 15 March to 5 April 2010 (Table 3). Peak abundance reached 42,056 via ground inventory on 23 March and 87,145 on 29 March via aerial inventory. We observed 23 species of waterfowl during spring 2010 (19 species of ducks, 3 species of geese and 1 swan species). Northern Shoveler was the most abundant species during ground inventories, accounting for 22.1% of total waterfowl abundance, followed by Lesser Scaup (15.2%) and Ruddy Ducks (15.0%). Diving ducks were slightly more abundant than dabbling ducks, accounting for 54.6% and 45.4% of the total waterfowl abundance, respectively. We estimated total UD's of 1,074,691 during spring 2010 based on ground inventories.

### *Fall*

We conducted 12 aerial inventories at Emiquon from 8 September to 14 December (Table 4). We observed 20 species of waterfowl during fall 2010 (16 duck species, 3 goose species, 1 swan species) with a peak abundance of 62,872 on 8 November. Northern Pintails (17.6%) were the most abundant species, followed by Gadwalls (17.0%) and American Green-winged Teal (15.7%). Estimated fall waterfowl UD's at Emiquon totaled 3,819,574. Dabbling ducks (3,475,903 UD's) accounted for 91.0% of UD's, whereas only 8.1% of waterfowl use during fall was attributable to diving ducks (309,346 UD's).

## **Non-Waterfowl Abundance**

### *Spring*

In addition to waterfowl, we documented 11 waterbird and raptor species during ground counts in spring 2010 (Table 5). Peak abundance of non-waterfowl species based on ground inventories was 26,535 individuals and occurred on 23 March, whereas aerial inventories

revealed a peak of 96,075 on 5 April (Table 6). American Coots were the most common species observed and accounted for 85.7% and 97.5% of non-waterfowl abundance based on ground and aerial inventories, respectively. American Coot abundance peaked at 25,888 (93,130 via aerial inventories), while their overall use of Emiquon during spring 2010 totaled 650,588 UD. Other commonly observed species included American White Pelicans, Double-crested Cormorants, and Pied-billed Grebes.

### *Fall*

We also estimated abundances of American White Pelicans, American Coots, Double-crested Cormorants, and Bald Eagles during 12 aerial inventories of waterfowl (Table 7). American Coots were the most abundant of these species, with a peak estimate of 95,040 on 2 November; they constituted 97.6% of non-waterfowl abundance during fall. Likewise, American Coots accounted for 97.3% (3,094,350 UD) of non-waterfowl use, followed by American White Pelicans (1.9%), and Double-crested Cormorants (0.7%). Nearly half (44.2%) of all waterbird use (including waterfowl) at Emiquon was attributable to American Coots.

### **Waterfowl Behavior**

We conducted behavior observations on 4 days between 10 March and 20 April 2010. Species observed included Northern Shoveler, Gadwall, Lesser Scaup, Ring-necked Duck, and Ruddy Duck. Overall, these species spent most of their time feeding (58.1%), followed by locomotion (20.9%; Table 8). However, when considered by guild, dabbling ducks spent 81.2% of their time feeding, whereas diving ducks only spent 19.7% of their time feeding. Locomotion (38.3%) and resting (30.6%) were the most common activities of diving ducks.

### **Brood Observations**

We completed 6 fixed-point brood surveys from 4 June to 12 August 2010 and recorded 142 waterbird broods comprised of 4 species (Table 9). The most abundant broods recorded were Wood Ducks ( $n = 91$ ), followed by Canada Geese ( $n = 32$ ), Mallards ( $n = 15$ ), and Pied-billed Grebes ( $n = 4$ ). Brood observations peaked ( $n = 35$ ) on 14 July, and age classes of broods increased throughout the observation period.

### **Moist-soil Plant Seeds**

We extracted 20 core samples from random locations at Emiquon on 14 October 2010. Average moist-soil plant seed biomass was 629.5 kg/ha (dry mass; Table 10). Large seeds contributed 421.9 kg/ha, whereas small seeds accounted for the remaining 207.6 kg/ha. The estimated energetic carrying capacity from moist-soil plant seeds in 2010 was 5,389 EUDs/ha.

## **DISCUSSION**

### **Waterfowl Abundance**

#### *Spring*

During spring 2010, ground inventories indicated UD<sub>s</sub> declined for the first time and were the lowest since monitoring began (1,074,691 UD<sub>s</sub>). This UD estimate represented a 42.6% decrease from spring 2009 (1,872,144 UD<sub>s</sub>) and a 24.4% decrease from spring 2008 (1,421,670 UD<sub>s</sub>). Because the size of the wetland changed considerably, we also expressed duck use estimates as densities (UD/ha). Similarly, duck-use densities were lowest during spring 2010 (553 UD/ha) compared to a high of 4,902 UD/ha during fall 2007. The low UD/ha estimate for spring 2010 was somewhat surprising given that fall 2009 UD<sub>s</sub> (>3 million) were relatively high. It's probable this apparent decline was a function of the frequency of ground inventories (bi-weekly) rather than actual reductions in waterfowl abundance. For instance, aerial inventory data indicated a peak in waterfowl abundance that was more than twice that of ground

inventories, occurred during a week when a ground count was not conducted. Furthermore, ice melt was late during spring 2010 and inventories did not begin until 3 March, whereas in prior years they began mid-February. It's possible that spring migration was compressed in 2010 and ducks did not stay as long as in previous springs.

### *Fall*

Our fall 2010 estimate of duck UD<sub>s</sub> (3,787,499) was 10.7% greater than in fall 2009 and the highest since monitoring began in 2007. This was undoubtedly influenced by a 33% increase in use by dabbling ducks (highest recorded); however, diving duck use declined by nearly 62%. Northern Pintails were the most abundant duck at Emiquon, and their use (663,895 UD<sub>s</sub>) in fall 2010 increased 233% from fall 2009. The 2010 UD estimate was the third highest recorded for Northern Pintails at a single location in the Illinois River valley (IRV) since aerial inventories began in 1948 (M. Horath, unpublished data). This is particularly noteworthy as continental population estimates of Northern Pintails have been below the North American Waterfowl Management Plan (NAWMP) goal (5.6 million) for 35 years (Zimpfer et al. 2010). Blue-winged Teal use (659,503 UD<sub>s</sub>) also increased by an impressive 275% over fall 2009 estimates and was the highest ever recorded from aerial inventories in the IRV and central Mississippi River valley. Likewise, use of Emiquon by American Green-winged Teal (607,868 UD<sub>s</sub>) and Gadwalls (607,453 UD<sub>s</sub>) was also the highest recorded in the IRV (M. Horath, unpublished data). These dramatic increases in use by dabbling ducks and the substantial decline in diving duck use may have been at least partially attributed to changes in wetland habitat conditions at Emiquon. For instance, the late-season drawdown created large areas of shallow water habitat along with mudflats that early-migrant dabbling ducks find attractive, while reducing the amount of submersed aquatic vegetation favored by many diving ducks. Moreover, the amount of forage

produced in other IRV wetlands was limited in 2010 due to flooding during the growing season, further contributing to the attractiveness of Emiquon to waterfowl.

We also calculated duck use per unit area of wetland (UD/ha) because the size of wetland area at Emiquon has changed considerably each year since restoration efforts began. The estimated duck-use density was 2,870 UD/ha during fall 2010. To compare duck use at Emiquon with another important waterfowl refuge in the IRV, we calculated fall duck-use densities at Chautauqua National Wildlife Refuge (CNWR) during 1991–2008. Duck-use densities at CNWR averaged 2,632 UD/ha during this period, and ranged from 133–9,925 UD/ha. Therefore, duck-use density at Emiquon during fall 2010 exceeded the average duck-use density at CNWR, and was the highest observed since fall 2007. For purposes of this report, we calculated the duck-use density estimate at Emiquon using average water-level gauge readings taken throughout fall (K.D. Blodgett, personal communication) rather than from the results of our wetland habitat map, which was incomplete at the time of this report. Accordingly, this estimate may change when the 2010 wetland covermap is completed.

## **Non-Waterfowl Abundance**

### *Spring*

Similar to waterfowl, we observed an apparent reduction in non-waterfowl bird use and diversity during spring 2010 ground inventories. American Coot abundance and UDUs declined 69.1% and 50.2%, respectively, from spring 2009 estimates and were the lowest to date. Nevertheless, the apparent reductions in abundance from ground inventories were not reflected in our observations during aerial inventories. For example, aerial inventory data indicated a peak abundance of 93,130 American Coots (highest recorded in spring) occurred on 5 April, whereas ground inventories revealed a peak of only 25,888 on 23 March. Ground inventories were only

conducted bi-weekly, and aerial inventories (conducted weekly) detected large increases followed by a sudden decline in American Coots between ground inventories (22 March–8 April). Consequently, it seems logical that ground inventories missed the peak migration of American Coots due to the bi-weekly schedule of our surveys. Thus, we will conduct ground inventories weekly during spring 2011.

### *Fall*

The UD estimate of American Coots during fall 2010 (3,094,350) at Emiquon was 27% lower than the fall 2009 estimate. However American Coot (4,249,563 UDs) use at Emiquon in fall 2009 was the highest observed for any surveyed location since the inception of aerial inventories in the IRV (M. Horath, unpublished data). Correspondingly, the fall 2010 UD estimate was the second highest ever recorded for coots in the IRV. Use of Emiquon by American White Pelicans (+45.2%), Bald Eagles (+257%), and Double-crested Cormorants (+53.4%) increased substantially over fall 2009 and exponentially since 2007. It is difficult to overemphasize the regional importance of Emiquon to migratory waterbirds, especially given that use by some species in 2010 was higher than previously recorded at any other wetland in the IRV since aerial surveys began in 1948.

### **Waterfowl Behavior**

Ducks observed at Emiquon spent most of their time feeding (58.1%) during spring 2010. However, dabbling ducks (Gadwalls, Northern Shovelers) spent 81.2% of their time feeding, whereas diving ducks (Lesser Scaup, Ring-necked Ducks, Ruddy Ducks) spent only 19.7% of their time feeding. Our observations were generally consistent with those from other time-activity studies of Anatids. For example, Paulus (1988) reported species that foraged on leafy aquatic vegetation spent more time feeding. Aquatic plants, an abundant food source at

Emiquon, are usually characterized by high water and fiber content and lower gross energy. Gadwall diets in Louisiana consisted almost entirely (95%) of aquatic vegetation and algae, and consequently, they spent 80% of their time during the day feeding to meet nutrient requirements (Paulus 1984). In contrast, non-breeding diving ducks (*Aythya*) foraging primarily on animal matter usually spent <30% of their time feeding (Paulus 1988, Bergan et al. 1989, Crook et al. 2009), because these foods contain higher gross energy and more nutrients than vegetation (Driver et al. 1974). Thus, waterfowl species with diets containing animal foods would be expected to spend less time foraging than those with diets dominated by vegetation.

### **Brood Observations**

Total broods observed at Emiquon in spring 2010 ( $n = 142$ ) increased 24.6% from spring 2009 ( $n = 114$ ), but species diversity declined 42.8% between 2009 ( $n = 7$ ) and 2010 ( $n = 4$ ), and was the lowest recorded to date. Likewise, observations of Pied-billed Grebe broods were the lowest ( $n = 4$ ) since surveys began, representing a 63.6% decline from spring 2009. We did not detect the first grebe broods until 29 July, which was 3 weeks later than the first grebe broods observed in 2008 and 2009. The most unexpected change in brood sightings at Emiquon involved American Coots. We could not document any American Coot reproduction during 2010. We recorded a 45.8% decline in the number of coot broods between 2008 ( $n = 24$ ) and 2009 ( $n = 13$ ), but did not anticipate this reproductive failure in 2010. Late-spring phenology and habitat disturbances from high water and shifting ice for 2 consecutive years likely caused nesting conditions to be less favorable for American Coots and Pied-billed Grebes. Our anecdotal observations indicated that there was more open water and less hemi-marsh for nesting waterbirds during spring brood observation periods. In contrast, observations of Wood Duck broods ( $n = 91$ ) in 2010 were the highest to date, representing a 35.8% increase over 2009.

Further, observations of Canada Goose broods ( $n = 32$ ) increased dramatically (+357%) over 2009 and also represented the highest count thus far. Canada Geese may have exploited the apparent increase of Muskrat (*Ondatra zibethicus*) lodges as nesting islands in Flag Lake during spring 2010. Similar to 2008 and 2009, age classes of broods continued to increase throughout the spring-summer observation period. Most of the broods were flighted and indistinguishable from adults by 12 August. Although species diversity declined and should be monitored further, broods continued to increase and survive to flight stage, indicating that Emiquon provided quality brood-rearing habitat for resident waterfowl in 2010.

### **Moist-soil Plant Seeds**

A desired KEA for Emiquon was an annual moist-soil plant seed production of 578 kg/ha, with  $\geq 800$  kg/ha considered to be very good production. In this context, moist-soil plant seed abundance was good in 2010 (629.5 kg/ha), representing a 168% increase over the 2009 estimate (235.3 kg/ha), and the highest since fall 2007 (992.4 kg/ha). Correspondingly, estimated energetic carrying capacity in 2010 (5,389 EUDs/ha) increased dramatically over the fall 2009 estimate (2,015 EUDs/ha) and was the highest since 2007 (8,496 EUDs/ha). For comparison, the Upper Mississippi River and Great Lakes Region Joint Venture (UMRGLRJV) of the North American Waterfowl Management Plan uses a seed abundance estimate of 514 kg/ha for waterfowl conservation planning in this region (derived from Souillere et al. 2007). Moist-soil plant seed yields at Illinois Department of Natural Resources (IDNR) waterfowl management areas averaged 691.3 kg/ha and energetic carrying capacity averaged 5,918 EUDs/ha during 2005–2007 (Stafford et al. 2008). Finally, Bowyer et al. (2005) estimated moist-soil plant seed abundance at CNWR averaged 790 kg/ha, corresponding to 6,760 EUDs/ha during 1999–2001. Thus, seed abundance and energetic estimates for moist-soil plants at



Emiquon during 2010 were similar to estimates used by the UMRGLRJV and those reported at IDNR sites, but less than the estimates for CNWR. We note that while moist-soil seed abundance at Emiquon increased substantially during 2010, the amount of seed actually available to waterfowl during fall was limited. Most of the moist-soil vegetation observed during fall 2010, especially large stands along the east side of Flag Lake, were never inundated and could not be used by migratory waterfowl. These areas will likely provide abundant forage if water levels increase during spring 2011.

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Table 1. Avian species observed during monitoring activities at The Emiquon Preserve, 2010.

| AOU Code <sup>a</sup> | Common Name                    | Scientific Name                  |
|-----------------------|--------------------------------|----------------------------------|
| ABDU                  | American Black Duck            | <i>Anas rubripes</i>             |
| AGWT                  | American Green-winged Teal     | <i>Anas crecca</i>               |
| AMCO                  | American Coot                  | <i>Fulica americana</i>          |
| AMWI                  | American Wigeon                | <i>Anas americana</i>            |
| AWPE                  | American White Pelican         | <i>Pelecanus erythrorhynchos</i> |
| BAEA                  | Bald Eagle                     | <i>Haliaeetus leucocephalus</i>  |
| BCNH                  | Black-crowned Night Heron      | <i>Nycticorax nycticorax</i>     |
| BEKI                  | Belted Kingfisher              | <i>Megaceryle alcyon</i>         |
| BLGO                  | Lesser Snow Goose (Blue Phase) | <i>Chen caerulescens</i>         |
| BLTE                  | Black Tern                     | <i>Chlidonias niger</i>          |
| BNST                  | Black-necked Stilt             | <i>Himantopus mexicanus</i>      |
| BUFF                  | Bufflehead                     | <i>Bucephala albeola</i>         |
| BWTE                  | Blue-winged Teal               | <i>Anas discors</i>              |
| CAGO                  | Canada Goose                   | <i>Branta canadensis</i>         |
| CANV                  | Canvasback                     | <i>Aythya valisineria</i>        |
| COGO                  | Common Goldeneye               | <i>Bucephala clangula</i>        |
| COME                  | Common Merganser               | <i>Mergus merganser</i>          |
| DCCO                  | Double-crested cormorant       | <i>Phalacrocorax auritus</i>     |
| GADW                  | Gadwall                        | <i>Anas strepera</i>             |
| GBHE                  | Great Blue Heron               | <i>Ardea herodias</i>            |
| GHOW                  | Great Horned Owl               | <i>Bubo virginianus</i>          |
| GREG                  | Great Egret                    | <i>Ardea alba</i>                |
| GRHE                  | Green Heron                    | <i>Butorides virescens</i>       |
| GWFG                  | Greater White-fronted Goose    | <i>Anser albifrons</i>           |
| HOME                  | Hooded Merganser               | <i>Lophodytes cucullatus</i>     |
| KILL                  | Killdeer                       | <i>Charadrius vociferus</i>      |
| LBHE                  | Little Blue Heron              | <i>Egretta caerulea</i>          |
| LESC                  | Lesser Scaup                   | <i>Aythya affinis</i>            |
| LSGO                  | Lesser Snow Goose              | <i>Chen caerulescens</i>         |
| MALL                  | Mallard                        | <i>Anas platyrhynchos</i>        |
| MUSW                  | Mute Swan                      | <i>Cygnus olor</i>               |
| NOHA                  | Northern Harrier               | <i>Circus cyaneus</i>            |
| NOPI                  | Northern Pintail               | <i>Anas acuta</i>                |
| NSHO                  | Northern Shoveler              | <i>Anas clypeata</i>             |
| PBGR                  | Pied-billed Grebe              | <i>Podilymbus podiceps</i>       |
| PEFA                  | Peregrine Falcon               | <i>Falco peregrinus</i>          |
| RBGU                  | Ring-billed Gull               | <i>Larus delawarensis</i>        |

Table 1. Continued.

| AOU Code <sup>a</sup> | Common Name            | Scientific Name           |
|-----------------------|------------------------|---------------------------|
| RBME                  | Red-breasted Merganser | <i>Mergus serrator</i>    |
| REDH                  | Redhead                | <i>Aythya americana</i>   |
| RNDU                  | Ring-necked Duck       | <i>Aythya collaris</i>    |
| RTHA                  | Red-tailed Hawk        | <i>Buteo jamaicensis</i>  |
| RUDU                  | Ruddy Duck             | <i>Oxyura jamaicensis</i> |
| SACR                  | Sandhill Crane         | <i>Grus canadensis</i>    |
| SORA                  | Sora                   | <i>Porzana carolina</i>   |
| TRUS                  | Trumpeter Swan         | <i>Cygnus buccinator</i>  |
| WODU                  | Wood Duck              | <i>Aix sponsa</i>         |

<sup>a</sup>According to the American Ornithologists' Union Check-list, 1998.

Table 2. Estimates of waterfowl abundance from ground inventories at The Emiquon Preserve during spring 2010.

| Species <sup>a</sup> | Inventory Dates |        |        |        |        | Total (%)     |
|----------------------|-----------------|--------|--------|--------|--------|---------------|
|                      | 3 Mar           | 10 Mar | 23 Mar | 8 Apr  | 20 Apr |               |
| AGWT                 | 0               | 60     | 23     | 2      | 8      | 93 (0.1)      |
| AMWI                 | 0               | 42     | 131    | 310    | 0      | 483 (0.5)     |
| BUFF                 | 38              | 348    | 926    | 828    | 140    | 2,280 (2.3)   |
| BWTE                 | 0               | 0      | 39     | 1,990  | 499    | 2,528 (2.6)   |
| CAGO                 | 175             | 96     | 39     | 7      | 24     | 341 (0.4)     |
| CANV                 | 75              | 334    | 234    | 1      | 0      | 644 (0.7)     |
| COGO                 | 150             | 210    | 3      | 0      | 0      | 363 (0.4)     |
| COME                 | 0               | 70     | 0      | 0      | 1      | 71 (0.1)      |
| GADW                 | 10              | 370    | 1,671  | 2,750  | 2,260  | 7,061 (7.3)   |
| GWFG                 | 0               | 52     | 0      | 0      | 0      | 52 (0.1)      |
| HOME                 | 10              | 0      | 52     | 0      | 2      | 64 (0.1)      |
| LESC                 | 150             | 1,061  | 10,220 | 2,922  | 401    | 14,754 (15.2) |
| LSGO                 | 0               | 13,731 | 18     | 0      | 2      | 13,751 (14.2) |
| MALL                 | 75              | 2,637  | 2,194  | 614    | 201    | 5,721 (5.9)   |
| MUSW                 | 1               | 2      | 2      | 4      | 5      | 14 (0.0)      |
| NOPI                 | 0               | 168    | 4      | 0      | 0      | 172 (0.2)     |
| NSHO                 | 0               | 944    | 10,016 | 7,058  | 3,498  | 21,516 (22.1) |
| RBME                 | 0               | 0      | 0      | 0      | 5      | 5 (0.0)       |
| REDH                 | 10              | 88     | 16     | 0      | 0      | 114 (0.1)     |
| RNDU                 | 225             | 1,430  | 8,617  | 2,085  | 42     | 12,399 (12.8) |
| RUDU                 | 0               | 525    | 7,851  | 4,351  | 1,805  | 14,532 (15.0) |
| TRUS                 | 3               | 7      | 0      | 0      | 0      | 10 (0.0)      |
| Unk. Ducks           | 0               | 150    | 0      | 0      | 0      | 150 (0.2)     |
| WODU                 | 0               | 4      | 0      | 10     | 11     | 25 (0.0)      |
| Total                | 922             | 22,329 | 42,056 | 22,932 | 8,904  | 97,143        |

<sup>a</sup> See table 1.



Table 3. Estimates of waterfowl abundance from aerial inventories at The Emiquon Preserve during spring 2010.

| Species <sup>a</sup> | Inventory Dates |        |        |        | Total (%) |        |
|----------------------|-----------------|--------|--------|--------|-----------|--------|
|                      | 15 Mar          | 22 Mar | 29 Mar | 5 Apr  |           |        |
| AGWT                 | 425             | 440    | 4,390  | 4,250  | 9,505     | (5.2)  |
| AMWI                 | 100             | 440    | 1,500  | 1,415  | 3,455     | (1.9)  |
| BUFF                 | 200             | 875    | 7,315  | 200    | 8,590     | (4.7)  |
| BWTE                 | 0               | 0      | 0      | 1,415  | 1,415     | (0.8)  |
| CANV                 | 210             | 440    | 50     | 0      | 700       | (0.4)  |
| COGO                 | 1,060           | 1,310  | 0      | 0      | 2,370     | (1.3)  |
| COME                 | 100             | 0      | 0      | 0      | 100       | (0.1)  |
| GADW                 | 1,060           | 2,185  | 7,315  | 7,085  | 17,645    | (9.7)  |
| LESC                 | 1,695           | 8,740  | 29,255 | 11,335 | 51,025    | (28.0) |
| MALL                 | 3,180           | 2,185  | 5,850  | 2,835  | 14,050    | (7.7)  |
| NOPI                 | 425             | 440    | 0      | 0      | 865       | (0.5)  |
| NSHO                 | 2,120           | 10,925 | 14,630 | 14,170 | 41,845    | (23.0) |
| REDH                 | 100             | 100    | 750    | 200    | 1,150     | (0.6)  |
| RNDU                 | 3,180           | 2,185  | 4,390  | 1,415  | 11,170    | (6.1)  |
| RUDU                 | 2,120           | 200    | 11,700 | 4,250  | 18,270    | (10.0) |
| Total                | 15,975          | 30,465 | 87,145 | 48,570 | 182,155   |        |

<sup>a</sup> See table 1.

Table 4. Estimates of waterfowl abundance from aerial inventories at The Emiquon Preserve during fall 2010.

| Species <sup>a</sup> | Inventory Dates |        |        |        |        |        |        |        |        |        |       |        | Total         |
|----------------------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|---------------|
|                      | 8 Sep           | 14 Sep | 20 Sep | 11 Oct | 18 Oct | 25 Oct | 2 Nov  | 8 Nov  | 16 Nov | 23 Nov | 3 Dec | 14 Dec |               |
| ABDU                 | 0               | 0      | 0      | 0      | 0      | 0      | 0      | 380    | 370    | 300    | 0     | 0      | 1,050 (0.2)   |
| AGWT                 | 1,330           | 1,215  | 3,410  | 11,920 | 11,370 | 11,675 | 7,165  | 11,545 | 7,800  | 1,560  | 300   | 0      | 69,290 (15.7) |
| AMWI                 | 0               | 0      | 345    | 2,200  | 3,290  | 4,190  | 2,785  | 2,290  | 2,220  | 500    | 0     | 0      | 17,820 (4.0)  |
| BUFF                 | 0               | 0      | 0      | 0      | 0      | 0      | 0      | 380    | 0      | 985    | 555   | 0      | 1,920 (0.4)   |
| BWTE                 | 19,020          | 24,200 | 15,495 | 5,850  | 2,000  | 0      | 0      | 0      | 0      | 0      | 0     | 0      | 66,565 (15.0) |
| CAGO                 | 150             | 125    | 95     | 245    | 140    | 600    | 460    | 500    | 535    | 235    | 70    | 0      | 3,155 (0.7)   |
| CANV                 | 0               | 0      | 0      | 0      | 0      | 25     | 1,395  | 380    | 740    | 300    | 200   | 0      | 3,040 (0.7)   |
| COGO                 | 0               | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 960    | 0     | 0      | 960 (0.2)     |
| GADW                 | 870             | 1,685  | 2,440  | 5,700  | 7,880  | 7,085  | 9,880  | 15,560 | 18,700 | 4,830  | 700   | 0      | 75,330 (17.0) |
| GWFG                 | 0               | 0      | 0      | 0      | 0      | 50     | 0      | 200    | 0      | 200    | 0     | 0      | 450 (0.1)     |
| HOME                 | 0               | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 20     | 0      | 200   | 0      | 220 (0.0)     |
| LESC                 | 0               | 0      | 0      | 0      | 0      | 0      | 0      | 380    | 0      | 300    | 0     | 0      | 680 (0.2)     |
| LSGO                 | 0               | 0      | 0      | 0      | 0      | 0      | 0      | 100    | 100    | 100    | 0     | 0      | 300 (0.1)     |
| MALL                 | 1,890           | 2,490  | 3,480  | 5,550  | 7,730  | 7,035  | 7,065  | 9,205  | 7,500  | 7,760  | 1,600 | 5      | 61,310 (13.9) |
| NOPI                 | 270             | 280    | 3,440  | 11,070 | 11,020 | 9,880  | 11,250 | 12,445 | 15,000 | 3,320  | 0     | 0      | 77,975 (17.6) |
| NSHO                 | 770             | 700    | 1,770  | 3,350  | 5,485  | 6,985  | 4,180  | 3,815  | 2,220  | 1,610  | 200   | 0      | 31,085 (7.0)  |
| REDH                 | 0               | 0      | 0      | 0      | 0      | 0      | 695    | 100    | 0      | 0      | 0     | 0      | 795 (0.2)     |
| RNDU                 | 0               | 0      | 0      | 1,100  | 1,000  | 1,400  | 795    | 2,590  | 840    | 100    | 225   | 0      | 8,050 (1.8)   |
| RUDU                 | 0               | 0      | 0      | 2,200  | 1,000  | 4,100  | 4,180  | 3,000  | 3,300  | 3,120  | 1,300 | 150    | 22,350 (5.1)  |
| SWAN                 | 0               | 0      | 0      | 0      | 0      | 0      | 10     | 2      | 7      | 0      | 10    | 0      | 29 (0.0)      |
| Total                | 24,300          | 30,695 | 30,475 | 49,185 | 50,915 | 53,025 | 49,860 | 62,872 | 59,352 | 26,180 | 5,360 | 155    | 442,374       |

<sup>a</sup> See table 1.

Table 5. Estimates of waterbird and raptor abundance from ground inventories at The Emiquon Preserve during spring 2010.

| Species <sup>a</sup> | Inventory Date |        |        |        |        | Total (%)     |
|----------------------|----------------|--------|--------|--------|--------|---------------|
|                      | 3 Mar          | 10 Mar | 23 Mar | 8 Apr  | 20 Apr |               |
| AMCO                 | 1              | 1,164  | 25,888 | 14,781 | 9,342  | 51,176 (85.7) |
| AWPE                 | 0              | 0      | 435    | 2,096  | 930    | 3,461 (5.8)   |
| BAEA                 | 0              | 5      | 2      | 0      | 0      | 7 (0.0)       |
| BEKI                 | 0              | 0      | 0      | 0      | 2      | 2 (0.0)       |
| DCCO                 | 0              | 0      | 50     | 2,545  | 667    | 3,262 (5.5)   |
| GBHE                 | 0              | 0      | 0      | 8      | 96     | 104 (0.2)     |
| GHOW                 | 0              | 1      | 0      | 0      | 0      | 1 (0.0)       |
| GREG                 | 0              | 0      | 0      | 14     | 0      | 14 (0.0)      |
| NOHA                 | 0              | 0      | 0      | 3      | 1      | 4 (0.0)       |
| PBGR                 | 0              | 10     | 160    | 387    | 1,152  | 1,709 (2.9)   |
| RTHA                 | 0              | 0      | 0      | 1      | 1      | 2 (0.0)       |
| Total                | 1              | 1,180  | 26,535 | 19,835 | 12,191 | 59,742        |

<sup>a</sup> See table 1.

Table 6. Estimates of waterbird abundance from aerial inventories at The Emiquon Preserve during spring 2010.

| Species <sup>a</sup> | Inventory Dates |        |        |        | Total (%)      |
|----------------------|-----------------|--------|--------|--------|----------------|
|                      | 15 Mar          | 22 Mar | 29 Mar | 5 Apr  |                |
| AMCO                 | 4,240           | 13,535 | 58,510 | 93,130 | 169,415 (97.5) |
| AWPE                 | 25              | 670    | 415    | 945    | 2,055 (1.2)    |
| DCCO                 | 0               | 150    | 65     | 2,000  | 2,215 (1.3)    |
| Total                | 4,265           | 14,355 | 58,990 | 96,075 | 173,685        |

<sup>a</sup> See table 1.

Table 7. Estimates of non-waterfowl abundance from aerial inventories at The Emiquon Preserve during fall 2010.

| Species <sup>a</sup> | Inventory Dates |        |        |        |        |        |        |        |        |        |       |        | Total (%)      |
|----------------------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|----------------|
|                      | 8 Sep           | 14 Sep | 20 Sep | 11 Oct | 18 Oct | 25 Oct | 2 Nov  | 8 Nov  | 16 Nov | 23 Nov | 3 Dec | 14 Dec |                |
| AWPE                 | 900             | 1,140  | 615    | 1,130  | 85     | 450    | 620    | 645    | 575    | 330    | 15    | 0      | 6,505 (1.7)    |
| AMCO                 | 1,720           | 3,190  | 4,410  | 62,865 | 59,775 | 92,210 | 95,040 | 18,900 | 19,710 | 6,340  | 700   | 0      | 364,860 (97.6) |
| BAEA                 | 0               | 0      | 0      | 2      | 5      | 6      | 16     | 14     | 19     | 21     | 10    | 7      | 100 (0.0)      |
| DCCO                 | 205             | 190    | 410    | 550    | 310    | 110    | 300    | 50     | 200    | 0      | 0     | 0      | 2,325 (0.6)    |
| Total                | 2,825           | 4,520  | 5,435  | 64,547 | 60,175 | 92,776 | 95,976 | 19,609 | 20,504 | 6,691  | 725   | 7      | 373,790        |

<sup>a</sup> See table 1.

Table 8. Behavior observations (%) of ducks at The Emiquon Preserve during spring, 2010.

| Group          | Month | Activity |      |        |            |       |
|----------------|-------|----------|------|--------|------------|-------|
|                |       | Feed     | Rest | Social | Locomotion | Other |
| Dabbling Ducks | March | 95.6     | 0.0  | 1.8    | 1.7        | 0.8   |
| Dabbling Ducks | April | 77.6     | 0.9  | 2.5    | 12.7       | 6.3   |
| Total Dabblers |       | 81.2     | 0.7  | 2.4    | 10.5       | 5.2   |
| Diving Ducks   | March | 19.7     | 30.6 | 0.8    | 38.2       | 10.7  |
| Total Ducks    |       | 58.1     | 11.9 | 1.8    | 20.9       | 7.2   |

Table 9. Waterbird brood observations at The Emiquon Preserve during 2010.

| Species <sup>a</sup>     | Observation Dates |        |       |        |        |        | Total Broods | %    |
|--------------------------|-------------------|--------|-------|--------|--------|--------|--------------|------|
|                          | 4 Jun             | 16 Jun | 1 Jul | 14 Jul | 29 Jul | 12 Aug |              |      |
| WODU                     | 1                 | 10     | 20    | 32     | 26     | 2      | 91           | 64.1 |
| CAGO                     | 18                | 12     | 0     | 1      | 1      | 0      | 32           | 22.5 |
| MALL                     | 2                 | 3      | 4     | 2      | 4      | 0      | 15           | 10.6 |
| PBGR                     | 0                 | 0      | 0     | 0      | 2      | 2      | 4            | 2.8  |
| Total                    | 21                | 25     | 24    | 35     | 33     | 4      | 142          |      |
| Average age <sup>b</sup> | 2A                | 2B     | 2C    | 2B     | 2B     | 2C     |              |      |

<sup>a</sup> See table 1.

<sup>b</sup> Gollop and Marshall 1954

Table 10. Moist-soil plant seed abundance (kg/ha, dry mass) and energetic use-days (EUD) per hectare at The Emiquon Preserve, 2010.

| Year | Seed Size <sup>a</sup> | <u>n</u> | Abundance |       |       | EUDs      |       |
|------|------------------------|----------|-----------|-------|-------|-----------|-------|
|      |                        |          | $\bar{x}$ | SE    | CV(%) | $\bar{x}$ | SE    |
| 2010 | Large                  | 20       | 421.9     | 112.3 | 26.6  | 3,612     | 962   |
|      | Small                  | 20       | 207.6     | 64.5  | 31.1  | 1,778     | 552   |
|      | Total                  | 20       | 629.5     | 114.5 | 18.2  | 5,389     | 1,237 |

<sup>a</sup> Moist-soil seeds were classified as large (e.g., millets; retained by a #35 sieve) or small (e.g., nutgrasses, retained by a #60 sieve).

<sup>b</sup> Moist-soil plant seed estimates from Illinois Department of Natural Resources waterfowl management areas, fall 2005–2007 (Stafford et al. 2008).

Submitted by:

A handwritten signature in blue ink, appearing to read "Joshua D. Stafford". The signature is stylized with large, flowing letters and a prominent "J" and "S".

Joshua D. Stafford, Ph.D.  
Associate Research Professor  
Illinois Natural History Survey

Date: 14 January 2011.